THIS IS ONE VOLUME OF A SIX VOLUME SET WHICH INCLUDES:

VOLUME I: FIELD OPERATIONS (FO)
VOLUME II: GROUNDWATER (GW)
VOLUME III: GEOTECHNICAL (GT)
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SEDIMENT SAMPLING

EG&G ROCKY FLATS PLANT EMD MANUAL OPERATION SOP	Manual: Procedure No.: Page: Effective Date:	5-21000-OPS SW.6, Rev. 2 1 of 21 March 1, 1992
Category 2	Organization:	Environmental Management

TITLE:
SEDIMENT SAMPLING

Approved By: _____ MAY 12 1992
(Name of Approver) (Date)

1.0 TABLE OF CONTENTS

REVIEWED FOR CLASSIFICATION/UCNI
By _____
Date _____

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2.0 PURPOSE AND SCOPE

This SOP describes procedures that will be used at the Rocky Flats Plant (RFP) to collect bed material samples from streams, ditches, ponds, and samples of water deposited materials in dry areas that meet acceptable standards of accuracy, precision, comparability, representativeness, and completeness.

The methods defined in this SOP are inappropriate for sediment collection when water levels approach or overtop stream banks. The methods contained herein assume that field personnel can safely wade a stream, sample from the shore of a stream, sample from the shore of a pond, or maneuver a small boat in a pond. During sediment sampling operations, the proper personal protective equipment (PPE) will be worn, as described in the Health and Safety Plan (HSP).

3.0 RESPONSIBILITIES AND QUALIFICATIONS

Personnel sampling sediments will be geologists, hydrologists, engineers, or field technicians with an appropriate amount of applicable field experience or on-the-job training under supervision of another qualified person.

4.0 REFERENCES

4.1 SOURCE REFERENCES

The following is a list of references reviewed prior to the writing of this procedure:

Engineering Support Branch Standard Operating Procedures and Quality Assurance Manual. EPA. Region IV. Environmental Services Division. April 1986.

Environment, Safety and Health Directive. DOE Order 5400.1. November 1988.

Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA. Interim Final. U.S. Environmental Protection Agency. October 1988.

Guy, Harold P. Techniques of Water-Resources Investigations of the United States Geological Survey. Book 3: Applications of Hydraulics; Chapter C1, "Fluvial Sediment Concepts." U.S. Government Printing Office, Washington, D.C. 1978.

Guy, Harold P. and Vernon W. Norman. Techniques of Water-Resources Investigations of the United States Geological Survey. Book 3: Applications of Hydraulics; Chapter C2, "Field Methods for Measurement of Fluvial Sediment." U.S. Government Printing Office, Washington, D.C. 1976.

National Handbook of Recommended Methods for Water-Data Acquisition. U.S. Department of the Interior. Office of Water Data Coordination. Geological Survey. 1977.

Techniques of Water-Resources Investigations of the United States Geological Survey. Book 5: Laboratory Analysis; Chapter C1, "Laboratory Theory and Methods for Sediment Analysis." U.S. Government Printing Office, Washington, D.C. 1973.

The Environmental Survey Manual, DOE/EH-0053 Appendices E, F, G, H, I, J, and K. U.S. Department of Energy. Office of Environmental Audit. Washington D.C. August 1987.

4.2 INTERNAL REFERENCES

Related SOPs cross-referenced by this SOP are as follows:

- SOP FO.3, General Equipment Decontamination

- SOP FO.6, Handling of Personal Protective Equipment
- SOP FO.7, Handling of Decontamination Water and Wash Water
- SOP FO.9, Handling of Residual Samples
- SOP FO.10, Receiving, Labeling, and Handling Environmental Materials Containers
- SOP FO.13, Containerizing, Preserving, Handling, and Shipping of Soil and Water Samples
- SOP SW.1, Surface Water Data Collection Activities

5.0 METHODS

5.1 INTRODUCTION

The sampling methods described in this SOP are used to collect bed material samples for the chemical analysis of contaminants which may be contained within the upper layers of the streambeds or adsorbed onto the surface of streambed materials on the Rocky Flats Plant (RFP) property. The uppermost sediments in ponds may also be collected by methods discussed in this SOP for similar chemical analyses.

Sediments range in size from cobbles and boulders to fine silt. Table SW.6-1 shows a list of the common scale of particle sizes for sediments and serves as a reference for field personnel to understand the terms used in describing sediments in this SOP.

The field technicians will evaluate the site based on conditions and particle sizes and will record site conditions and particle sizes in the field logbook or on the Sediment Sample Collection Form included in this document. This will be performed prior to sample collection. (see Table SW.6-1).

TABLE SW.6-1

RECOMMENDED SCALE OF SIZES BY CLASSES FOR SEDIMENT ANALYSIS

Class Name	Metric Units (millimeters)	Metric Units (micrometers)	English Units (feet)
Boulders	>256.0		>0.840
Large cobbles	256.0 - 128.0		0.840 - 0.420
Small cobbles	128.0 - 64.0		0.420 - 0.210
Very coarse gravel	64.0 - 32.0		0.210 - 0.105
Coarse gravel	32.0 - 16.0		0.105 - 0.0525
Medium gravel	16.0 - 8.0		0.0525 - 0.0262
Fine gravel	8.0 - 4.0		0.0262 - 0.0131
Very fine gravel	4.0 - 2.0		0.0131 - 0.00656
Very coarse sand	2.0 - 1.0	2000.0 - 1000.0	0.00656 - 0.00328
Coarse sand	1.0 - 0.50	1000.0 - 500.0	0.00328 - 0.00164
Medium sand	0.5 - 0.25	500.0 - 250.0	0.00164 - 0.000820
Fine sand	0.25 - 0.125	250.0 - 125.0	0.000820 - 0.000410
Very fine sand	0.125 - 0.062	125.0 - 62.0	0.000410 - 0.000205
Coarse silt	0.062 - 0.031	62.0 - 31.0	0.000205 - 0.000103
Medium silt	0.031 - 0.016	31.0 - 16.0	0.000103 - 0.0000512
Fine silt	0.016 - 0.008	16.0 - 8.0	0.0000512 - 0.0000256
Very fine silt	0.008 - 0.004	8.0 - 4.0	0.0000256 - 0.0000128
Coarse clay	0.004 - 0.0020	4.0 - 2.0	
Medium clay	0.0020 - 0.0010	2.0 - 1.0	
Fine clay	0.0010 - 0.0005	1.0 - 0.5	
Very fine clay	0.0005 - 0.00024	0.5 - 0.24	

5.2 EQUIPMENT

The following equipment items may be used for bed material sampling operations:

- Decontamination equipment
- Boat
- Dredge, core sampler, or sludge sampler
- Sampler core tubes composed of stainless steel, Teflon®, or other chemically inert material
- Sample core liner caps
- Stainless steel, Teflon®-coated or glass scoop or spoon
- Teflon® tape
- Extension rods and connecting clamps
- Mixing pan
- Sieve
- Sample containers
- Sample transportation coolers

5.3 CRITERIA FOR SELECTION OF SAMPLING METHODS AND EQUIPMENT

The selection of sediment sampling devices and methods for their use are dependent on the objectives of the sampling study and other factors. Bed materials are being collected for the purpose of determining the presence, concentrations, and distribution of contaminants associated with these materials at the RFP. Composite samples will be collected to meet these objectives. In addition, information regarding the highest expected concentrations of some contaminants, specifically volatile organic compounds (VOCs), is desired.

The physical characteristics of the sediment site to be sampled are important factors in the selection of sampling devices and methods. These characteristics include:

- Grain size of bed materials
- Presence of water
- Type of water body
- Presence of organic material, rocks, or debris
- Accessibility to sampling location

Silts and clays generally possess the highest concentrations of contaminants. Therefore, areas of the finest grained sediments will be visually identified and used for the collection of VOCs. A core or sludge sampler will be used for VOC collection when water is present to help prevent disturbance of the samples. Check valves in these devices prevent washout during recovery. When collecting VOCs in dry sediments, an attempt should be made to use a core sampler; however, a stainless steel scoop may be used.

When fine grained materials are underlain by coarse materials, penetration of underlying sediments by corers or sludge samplers may be prevented. If this field condition exists, the sludge sampler, with its butterfly valve segment removed, may be inserted into the bed materials at an angle. This method will retain water which overlies the bed material.

When collecting composite samples of stream bed materials, collection of sub-samples (aliquots) will be performed at points along cross-sections of streams. More than one cross-section may be used to provide sufficient sample material. Samplers should move slightly upstream to collect additional aliquots along cross-sections to avoid impacting sample quality. Stainless steel scoops, core or sludge samplers should be used for this purpose. However, if penetration of sediments is not possible, a dredge (clam-shell) sampler may be used. If data objectives require that only the

uppermost sediments be sampled, core samples may be partially taken at one point. The remainder of the composite may be taken at subsequent points along the cross-section.

When collecting composite samples of pond bed material, the preferred sampling strategy is to collect several aliquots from either randomly selected points or systematic grids at a sampling location. If sample points are randomly selected, they may be located near the center of the pond. If the location cannot be sampled without requiring the sampler to wade into the pond, the site should be sampled from a boat or with a dredge sampler. Extensions to the sampling devices may be required.

Organic material, rocks, or debris may be present in collected samples. These materials should be removed by sieving samples with a large screen sieve. Care should be taken in the selection of stream cross-sections and pond sampling grids to avoid collection of these materials.

5.4 SAMPLING PROCEDURES

Prior to sampling, initiate field notes regarding site conditions, sample team personnel, site identification, date, and sample identification. These items will be recorded on the Sediment Sample Collection Form found in Section 8.0, Documentation.

5.4.1 General Sampling Procedures

Typical steps to be followed in collecting any sediments are:

1. Select the appropriate sampling method and equipment to be used.

2. Decontaminate all sampling equipment.

3. Place all sampling equipment on plastic sheeting near the sampling location.

4. Collect samples.

4a. The core sampler or the sludge sampler will be used to collect the top 2 inches of bed materials for VOC analysis. To collect a VOC sample, push the tapered end of the core sampler into the bed material. This can be facilitated by dropping the top weight onto the sampler shaft, if using a piston-type sampler. The sampler should be pushed in far enough to fill the 2-inch core liner. Enclose the sample in the corer, per manufacturer's instructions, and retract the corer from the sediments. Remove the core liner and seal as follows:

- Place Teflon® tape over the ends of the tube
- Place liner caps securely over the Teflon® tape

4b. Non-sieved samples for grain size analysis will be taken with a core sampler or a sludge sampler. The method is the same as for VOC samples, however a full 6-inch core will be collected. Three 2-inch core liners will be used. This sample will be collected directly adjacent to the VOC sample location, in visually similar materials. Core will be sealed as described in 4a.

4c. Composite samples for the remaining analytes described in the project work plan will be collected and placed in a mixing pan. Refer to specific procedures found later in this section for composite sample collection methods.

5. Proceed to the sampling equipment location and then sieve the sample found in the mixing pan as described in Subsection 5.4.4, Sieving.

6. Mix the sample as described in Subsection 5.4.5, Mixing.

7. Fill sample containers for the remaining analytes. If liquid is present, attempt to maintain the proportion of solid to water that exists in the mixture while filling the sample containers, as discussed in Subsection 5.4.5, Mixing.

8. As each container is filled, carefully wipe the upper edges of the container with a paper towel so that sediments are removed from the threads and mouth of the jar. This is done to ensure that a tight seal exists after the container is closed.

9. After all sample containers have been filled, place the remaining sediment samples in a environmental container.

10. Decontaminate the sample containers by:

    10a. Rinsing the outside of the containers with distilled water.

    10b. Drying the outside of the containers with a paper towel.

11. Store all sample containers on ice in coolers for transportation.

12. Complete records of sample collection as described in SOP SW.1, Surface Water Data Collection Activities.

13. Decontaminate equipment as described in SOP FO.3, General Equipment Decontamination.

14. Perform personal decontamination as required by the HSP.

5.4.2 Sample Collection Using a Dredge, Stainless Steel Scoop, Core Sampler, or Sludge Sampler in Streams

Refer to Subsection 5.3, Criteria for Selection of Sampling Methods and Equipment for instruction regarding stream bed material sampling.

VOC and non-sieved, grain size analysis samples will be collected and sealed as described in Subsection 5.4.1, General Sampling Procedures.

The procedure for collecting streambed materials for other types of analyses using sampling devices described in Subsection 5.3, is as follows:

1. After determining the sampling point or points in the stream, either wade to the sampling point or place the proper number of extensions on the sampler to reach the proper point in the stream.

2. If wading, be sure to hold the sampling device upstream from yourself (facing into the oncoming current).

3. Slowly lower the sampling device to the stream bottom.

4. After the sampling device reaches the bottom of the stream, penetrate bed materials with the sampling device, and follow the manufacturer's instructions for enclosing the sample in the device.

5. Slowly raise the sampling device.

6. Empty the contents of the sampling device into the mixing pan. If more than one point is being sampled in order to obtain several aliquots to produce a composite sample, proceed to the next sampling point and collect additional samples, as described in Steps (3) through (5). When practical, aliquots comprising a given composite should be approximately equal volume. A beaker or similar device may be used to measure the aliquots before they are placed in the mixing pan. This is done to avoid biasing the sample in favor of any grid points.

7. Repeat Steps (3) through (6) until sufficient bed materials, as required by the project work plan, have been collected.

8. If sieving is required, sieve the materials as described in Subsection 5.4.4, Sieving.

9. Mix the sample material. Use the mixing procedure described in Subsection 5.4.5, Mixing.

10. Begin filling sample containers for the remaining analytes described in the project work plan.

11. As each container is filled, carefully wipe the upper edges of the container with a paper towel so that sediments are removed from the threads and mouth of the jar. This is done to ensure that a tight seal exists after the container is closed.

Attempt to maintain the proportion of water to solids that exists in the mixing pan while filling containers, as discussed in Subsection 5.4.5, Mixing.

12. After all sample containers have been filled, place the remaining sediment samples in a environmental container.

13. Decontaminate the sample containers by:

    13a. Rinsing the outside of the containers with distilled water.
    13b. Drying the outside of the containers with a paper towel.

14. Store all sample containers on ice in coolers for transportation.

15. Complete records of sample collection as described in SOP SW.1, Surface Water Data Collection Activities.

16. Decontaminate equipment as described in SOP FO.3, General Equipment Decontamination.

17. Perform personal decontamination as required by the HSP.

5.4.3 Sample Collection Using a Dredge, Core Sampler, or Sludge Sampler in a Pond

Two approaches for collecting bed materials are provided in Subsections 5.4.3.1 and 5.4.3.2. One approach is to attach a sampling device to an extension rod or cable, and to use this device while standing on the shore of the pond to collect a sample or multiple samples for compositing of bed

material from the bottom of the pond. This approach will be used when the dimensions of the pond do not exceed approximately 30 feet in diameter or 3 feet in depth.

If the pond dimensions exceed these measurements, then the second sampling approach, namely sampling from a boat, as described in Subsection 5.4.3.2, will be employed. The field crew will row to the sample collection point or points in the pond and collect a sample of bed material in a dredge, core sampler, or sludge sampler, as determined in Subsection 5.3, Criteria for Selection of Sampling Methods and Equipment.

5.4.3.1 Sediment Sampling From the Shore of the Pond

Ponds with dimensions not exceeding approximately 30 feet in diameter and 3 feet in depth will be sampled from the shore. The steps to be followed in obtaining bed material samples from these ponds are similar to sampling a stream from the shore of the stream. Refer to Subsection 5.4.1 for guidance in general procedural steps to be followed in collection of bed material samples from the shore of a pond. Refer to Subsection 5.3, Criteria for Selection of Sampling Methods and Equipment, for further instruction in collecting samples.

An important distinction between stream sampling and pond sampling is that in the case of sampling from a pond, due to the stagnant flow conditions in ponds, sampling personnel must not wade into the pond in order to obtain samples, because wading could agitate the bottom sediments and interfere with the collection of useful samples.

5.4.3.2 Sediment Sampling From a Boat

Refer to Subsection 5.3 for instruction in the selection of sampling methods and equipment.

Ponds with dimensions in excess of approximately 30 feet in diameter and 3 feet in depth will be sampled from a boat. The steps to be followed in obtaining bed material samples from these types of ponds is as follows:

1. Decontaminate the boat, anchor, and all sampling equipment in accordance with the procedures described in SOP FO.3, General Equipment Decontamination.

2. Arrange decontaminated sampling equipment, sample mixing tray, sample containers, and sample cooler on plastic sheeting inside the boat.

3. Carefully launch the boat. Two samplers then enter the boat. A third crew member remains on shore.

4. Row the boat to the first sampling point in the pond.

5. Anchor the boat.

6. Slowly lower the sampling device over the side of the boat.

7. Refer to Subsection 5.4.1. Perform Steps (4) through (14) to complete sampling operations.

5.4.4 Sieving

If required by the project workplan, sieve the material in the mixing pan. The object of sieving is to eliminate those particles greater in diameter than a particular, desired grain size.

A number 10 mesh sieve should be used to remove all particles larger than 2 millimeters in diameter. If present, cobbles, large pebbles and/or pieces of vegetation should be removed from the sample. This is done by pre-sieving with a number 8 sieve. Record and perform sieving as follows:

1. Size and type of sieve (for example: 12-inch diameter brass with stainless-steel mesh)
2. Mesh size of sieve (for example: number 10 sieve)
3. Sieve the entire volume of collected sediments
4. Collect sieved sediments in mixing pan

5.4.5 Mixing

Sediments collected for analyses of constituents other than VOCs and the non-sieved grain size samples will be thoroughly mixed before the samples are placed into the sample containers. In addition, the samples may be sieved prior to mixing, as discussed in Subsection 5.4.4, Sieving. The sediment will be removed from the sampling device and placed in a glass container, Teflon®-coated stainless steel pan, or a stainless steel pan then mixed using a stainless steel or Teflon®-coated stainless steel spoon or a stainless steel scoop. The sediment will be scraped from the sides, corners, and bottom of the pan, rolled to the center of the pan, and mixed.

The sample is then to be quartered and moved to the four corners of the mixing pan. Each quarter of the sample will then be mixed individually. Each quarter is then rolled to the center of the

container, and the entire sample is mixed together. This procedure will be continued to ensure that all parts of the sample are mixed as well as possible, and that the sample is as homogeneous as possible before being placed in the sample containers. Mixed samples are then placed in sample containers.

If water is present in the sample mixture that is obtained by use of a sludge or core sampler, then an attempt will be made to preserve the water-to-solid ratio by including the water as part of the sample. This will be done by following these measures:

1. Use the stainless steel scoop to place scoops full of sample/water mixture into each jar.

2. Remix the sample/water mixture remaining in the mixing pan after each scoop of material is placed in a sample jar.

3. Fill each sample container only partially. Then, beginning with the first container, add additional sample to each container. Continue in this manner until all containers have been filled. This approach is used to evenly distribute the liquid into the various sample containers, while endeavoring to maintain the solid-to-liquid ratio present in the samples collected in the core or sludge sampler.

4. If the mixture is high in liquid content, the mixture may be poured into a stainless steel beaker in order to more efficiently transfer the mixture into sample containers. Continued mixing with a spoon will be provided to maintain homogeneity of the sample mixture during filling of sample bottles, as discussed in (3) above.

5.4.6 Sampling Dry Sediments

Sampling personnel will be required to wear level C personal protective equipment (including a respirator) in order to perform sampling of dry sediments. Refer to the Health and Safety Plan for a description of procedures and equipment.

For the case of sampling dry sediments, procedures are as follows:

1. Collect samples for analysis for VOCs in the core sampler or sludge sampler. Follow the steps outlined in Subsection 5.4.1, Step (4a). If unable to collect sufficient sample material with the core samples, use the stainless steel scoop.

2. Collect samples for non-sieved grain size analysis in the core samples. If unable to collect sufficient sample material with the core samples, use the stainless steel scoop. Follow the procedure outlined in Subsection 5.4.1, Step (4b).

3. Collect dry samples from discrete points by use of the stainless steel scoop. Place the samples into the mixing pan. Continue collection until sufficient materials have been obtained. Follow Steps (8) through (17) in Subsection 5.4.1 to complete sampling.

6.0 QUALITY ASSURANCE/QUALITY CONTROL

Quality Assurance (QA) and Quality Control (QC) activities will be accomplished according to applicable project plans as well as quality requirements presented in this SOP.

QC samples for sediment sampling fall into two categories:

- Duplicate
- Equipment rinsate

SOP FO.13, Containerizing, Preserving, Handling, and Shipping of Soil and Water Samples describes the general handling of samples. The Workplan/Quality Assurance Addendum (QAA) specifies QC sampling frequencies.

Sample collection procedures for duplicate samples will be the same as those described for regular samples in Section 5.0. These samples are intended to be as close to exact replicates of the original samples as possible. They are obtained immediately adjacent to the samples that they are intended to duplicate.

A rinsate sample from sampling equipment is intended to check for potential contamination of the sample by the sampling equipment. The equipment rinsate is a measure of the quality of decontamination procedures. For the bed material sampling operation, a rinsate sample will be collected from sampling equipment with any liners in place before the sampling equipment is used. Sampling equipment will be rinsed with approximately 3 liters of distilled water which will be collected in a decontaminated stainless steel bowl. A decontaminated glass or stainless steel beaker will be used to dip the water from the bowl and fill the sample bottles. The rinsate samples will be analyzed for the same parameters as the bed material samples.

7.0 ENVIRONMENTAL MANAGEMENT

Sampling sites associated with environmental restoration at RFP fall into two categories: potentially contaminated and not potentially contaminated. Background locations are identified in SOP FO.10, Receiving, Labeling, and Handling Environmental Materials Containers. At sediment sampling

stations that have not been verified as background locations, environmental materials will be handled in accordance with SOP FO.10.

Sediment stations which have been identified as not potentially contaminated, environmental materials will be handled in accordance with:

- SOP FO.6, Handling of Personal Protective Equipment
- SOP FO.7, Handling of Decontamination Water and Wash Water
- SOP FO.9, Handling of Residual Samples

8.0 DOCUMENTATION

Information required by this SOP will be documented on the Sediment Sample Collection Form (Form SW.6A) that follows.

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT FORM SW.6A

SEDIMENT SAMPLE COLLECTION FORM

SAMPLE ID:_____ SITE ID:_____ LOCATION:_____

NORTH OR Y: _____ EAST OR X: _____

COLLECTION DATE:_____ QUARTER: 1 2 3 4 DRY: Y / N

COLLECTION TIME:_____ PURPOSE: _____

COMPOSITE: Y / N

COMPOSITE DESCRIPTION: _____

QC TYPE: REAL MS MSD LR DUP RNS QC PARTNER:_____

COLLECTION METHOD: Scoop _____ Dredge _____ Core _____ Other _____

SIEVED: Y / N SIEVE SIZE NO: 10

SIEVE MATERIAL: FRAME _____ SCREEN _____

TEAM LEADER_____ TECH_____ TECH_____ TECH_____

VOLUME COLLECTED: _____ UNITS: _____

DEPTH OF WATER: _____ Feet

DEPTH OF TAKE: _____ Inches

COMMENTS: _____

SAMPLED FROM:

Shore Stream Boat Bridge Cross-Section Dry Area Other_____

SAMPLING CONDITIONS:

Stream Pond Dry Other _____

WEATHER:

Clear Calm Hot Sunny P/C Lt. Breeze Warm Fog Cloudy Windy Cool Rain

Gusty Cold Sleet V. Cold Snow Other _____

MATRIX: _____

REQUEST FOR ANALYSIS NO: _____

CHAIN OF CUSTODY NO: _____

SHIP DATE: _____

Sampler: _____

Prepared by: _____

Print Name Signature

Company: _____